The Flora of Turkey: past, present and future

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Résumé

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"Flora of Turkey" est un ouvrage critique multi-volumes édité par P. H. Davis à Edimbourg, publié actuellement à moitié (4 volumes sur 8 prévus). Après une introduction succincte au sujet de l'historique de l'ouvrage, les auteurs en définissent le but et le cadre, en relevant quelques problèmes d'ordre technique et quelques difficultés matérielles qui sont d'un intérêt général pour les auteurs de flores. En particulier, ils insistent sur les relations avec la recherche botanique qui se fait en Turquie, expliquant les raisons pour lesquelles la flore n'a pu s'écrire dans le pays même et soulignant les apports de botanistes turcs au texte de l'ouvrage. Ils suggèrent aussi que la recherche botanique, en Turquie, devrait dans le futur profiter et s'inspirer de cette flore, et ceci dans bien des domaines d'application: monographies classiques, études bio- et chémosystématiques, et surtout recherches de terrain sur la variabilité, l'écologie et la biologie des taxons. Se faisant les avocats de procédures taxonomiques saines, les auteurs stigmatisent les pratiques abusives d'un Ponert qui crée des centaines de taxons et combinaisons nouveaux sans avoir étudié un seul échantillon. Parmi les priorités futures, des mesures de conservation de la nature et la création d'un institut national turc de recherches taxonomiques sont soulignées.

Abstract

Davis, P. H. & I. C. Hedge (1975). The Flora of Turkey: past, present and future. *Candollea* 30: 331-351. With French abstract and Turkish summary.

"Flora of Turkey" is a multi-volume critical work edited by P. H. Davis in Edinburgh, of which one half is now published (4 of the 8 scheduled volumes). After a brief introductory sketch of its historical background, the authors proceed to outline the scope and framework of the Flora, pointing out some technical problems and material difficulties of general relevance to Flora-writers. They devote particular attention to the relations with botanical research in Turkey, explaining the reasons why the Flora could not be written within the country itself, stressing the present contribution of Turkish botanists to the Flora, and suggesting future lines of research, within Turkey, that could be based on the Flora: classical monographs, bio- and chemo-systematic studies, with particular emphasis on field observations on variation, ecology and biology. A plea is made for sound taxonomic work, and abusive practices, like Ponert's, creating hundreds of new taxa and combinations without seeing a single specimen, are stigmatised. Among future priorities, conservation measures and the creation of a national taxonomic research institute in Turkey are stressed.

Preface

In this contribution we review the progress of the *Flora of Turkey* and make suggestions for further research. Although we have written this paper primarily for Turkish readers, we hope that it is also of wider interest and that many of our comments, suggestions and references will be equally useful for other biologists interested in the floras of the Middle East and elsewhere.

The genesis, aims and development of the Flora project

Introduction

The idea of writing a Flora of Turkey arose fortuitously as a personal and optimistic vision. At the age of 20, P. H. Davis, during a plant-collecting trip in 1938, paid a two weeks visit to western Anatolia and climbed Boz Dağ, Honaz Dağ and Baba Dağ – mountains botanised by Boissier nearly a century before. The youthful collector was immediately impressed by the richness of the flora and the magnificent countryside. From that first exciting visit was born the desire to explore unbotanised regions of Anatolia; and, too, the determination eventually to write a Flora of Turkey.

The Second World War effectively stopped progress in either direction, but after it Davis took a botany degree at Edinburgh University with the avowed intention of learning enough botany to put the original plans into action. After joining the lecturing staff at Edinburgh University in 1950, he was able to make a series of expeditions to Turkey, accompanied on some of them by Ian Hedge, Oleg Polunin, Professor Kâmil Karamanoğlu, Professor Riza Çetik and Doç. Dr. Faik Yaltirik.

These journeys, ten in all since the war, resulted in very large collections (c. 27 000 numbers) being amassed at the herbarium of the Royal Botanic Garden, Edinburgh (E); duplicates are often represented at Kew (K), the British Museum, Natural History, (BM), the University Botany Department at Ankara (ANK) and the Forestry Faculty at Istanbul (ISTO). These expeditions, together with the independent and similarly productive efforts of Dr. A. Huber-Morath of Basel, resulted in the description of many new species. By this time it had become quite clear that writing a Flora of Turkey, with perhaps about 8000 species, was a much bigger and more complex task than it had seemed in the euphoria of the pre-war visit. It could not be accomplished without a great deal of help and money. Since the earliest days, the Royal Botanic Garden, Edinburgh, has dealt with the handling and curation of the collections, and the links and co-operation between the two bodies – one university, the other government – have always been very close. In 1961, a generous grant from the United Kingdom Science Research Council provided Davis, as editor of the embryonic Flora, with two full-time research assistantships. Without the continued support of the Science Research Council and the Royal Botanic Garden, progress on the Flora would not be possible.

Aims, contents and scope of the Flora

The unusual richness of the flora of Turkey is in large measure due to the fact that three separate phytogeographical regions are present: Mediterranean, Irano-Turanian and Euro-Siberian (Davis, 1971; Zohary, 1973). The former two regions are major gene centres in western Asia, and have contributed much to the origin of many field crops, fruit trees and ornamental plants. The Anatolian flora is therefore one of particular interest and importance, not only to the academic botanist, but also to the plant breeder, conservationist, phytogeographer, and to those involved with forestry, agriculture and horticulture. The need for a modern Flora therefore needs little stressing.

The *Flora of Turkey and the East Aegean islands* (1965–), published by the Edinburgh University Press, aims to include all flowering plants and vascular cryptogams wild or naturalised in Turkey, and also widely planted crops and introduced trees. In addition to covering modern Turkey, the Greek islands in the east Aegean (treated in Rechinger's *Flora aegaea,* 1943) are included because they are floristically closest to west Anatolia and are omitted from *Flora europaea.* The sequence of families in the Flora follows that adopted in Boissier's *Flora orientalis,* with some modifications (e.g. the Centrospermous families are grouped together in volume 2). The introduction to volume 1 explains the content and presentation of the Flora, and gives a brief phytogeographical account of Turkey. A list of major collections made in Turkey since Boissier's time appears in volume 2, and a change in the method summarising internal distributions is introduced in volume 3. Except for the necessity of deferring *Rubiaceae* to volume 6, no significant further changes are envisaged.[1]

Because identification is by means of indented dichotomous keys, may we point out that these need to be cautiously used? Intermediates do occur between many varieties, subspecies and even taxonomic species. A key is therefore a guide aimed at correct identification, but not an infallible one – authors (and users) make mistakes here and there.

Although the standard type of dichotomising key is the usual method of identification throughout the Flora, in volume 4 a different kind of key was introduced for the identification of the genera of *Umbelliferae.* In this, a multi-access key, a formula consisting of 8 letters of the alphabet was prepared for each of the 97 genera – each letter symbolising a feature. These formulae, 124 in all, were then arranged in alphabetical order. In order to identify an unknown genus, one simply writes down its formula and compares it with those listed in the Flora. In some cases, the formula itself is sufficient for identification, but in other cases different genera have the same formula. In these instances, distinguishing features are added and arranged in such a way that the unsuitable candidates can quickly be rejected. Such a key has the advantage over the conventional one in that even if some of the usually essential parts of the specimen are not represented – such as flowers or mature fruit – there is still a good chance of being able to identify the genus. Because this type of key proved very useful in the *Umbelliferae,* a family so

[1]Most new taxa described for the Flora are first published in the *Notes Roy. Bot. Gard. Edinburgh,* but from volume 3 onwards new names and combinations are often first published in the main text of the Flora and listed in an appendix.

often represented in herbaria by inadequate specimens, it has also been used in volume 5 for the 130 genera of the *Compositae.* In both these families, the *Compositae* and *Umbelliferae,* the standard type of dichotomous keys are also provided.

As with *Flora europaea,* the *Flora of Turkey* aims not to hide ignorance but to expose it. In notes and observations after the species account, doubts and difficulties are pointed out, indicating groups where further research is needed before the taxonomy can be clarified. Lack of adequate material is the most frequent cause of these uncertainties.

No first Flora of a country can hope to be definitive – new data and new discoveries are always coming to light. Even in Britain, where Floras have been written for more than 200 years, each new edition of a Flora shows significant changes from its predecessor! If the present *Flora of Turkey* provides a stimulus and practical framework for further research, it will have served its purpose.

Where to write a Flora

Some readers may wonder how we can prepare a Flora of Turkey in Edinburgh. There are obvious drawbacks. We cannot, for instance, go into the field when we feel like it to study the genus being revised. We primarily have to base our revisions on the excellent herbarium and library facilities at the Royal Botanic Garden, Edinburgh, supplemented by visits to the London herbaria at Kew and the British Museum. We rarely have biosystematic information, and chromosome counts based on Turkish material are so far usually too scattered to be of much taxonomic help.

Writing a basic Flora in Turkey, however, would be much more difficult, mainly for the following reasons. The inadequate herbarium representation both of type specimens and also of the flora of neighbouring countries would be crippling: no flora can be properly studied in national isolation. To decide the status of a plant (species or subspecies – two species or one?) needs a large herbarium. Dried material still remains the most effective way (despite obvious shortcomings) of comparing all available material in the same place, in the same state, and at the same time (Davis, 1961). Because of the narrow species concept widely adopted by most Soviet taxonomists in the *Flora SSSR,*[1] the flora of the Caucasus presents particular problems in revising groups centred in N.E. Anatolia (Kars and Artvin are covered in Grossheim's *Flora Kavkaza*); even with correctly identified Soviet material available, it is often very difficult to decide if plants in N.E. Anatolia and the Caucasus are conspecific or not.

Extensive library facilities are also essential for reliable floristic or monographic work: valuable information is often in obscure publications difficult to trace. The correct application of names requires reference to original descriptions. Synonymy is not just dead wood – it is often a source of information about the plant; the only illustration of a species, for instance, may be found under one of its synonyms. Fortunately, many classical collections are now available on microfiche, but it is often a very tricky business to decide which specimen of a species is

[1] For a discussion of the monotypic (Komarovian) versus the polytypic (trinomial) species concepts, see Czerepanov (1973: 11-18) and Davis & Heywood (1967).

to be treated as the type. We rely on libraries, of course, for many Turkish records, and for information on external distribution in the absence of herbarium material. One needs the wisdom of Solomon (Süleyman), however, to assess the value of many literature records: two variables confuse the issue – the variability of species and of taxonomic judgment. Without adequate herbarium and library facilities a Flora would be very incomplete and inaccurate. Unfortunately for Turkey, by an accident of history, most of these facilities – this basic store of information – are in western Europe.

Collaborators and the contributions of Turkish taxonomists

Collaboration with other botanists and herbaria has naturally grown as the Flora has proceeded. This collaboration mainly takes two forms. Firstly, the preparation of accounts by numerous experts outside Edinburgh; this involves the loan of our own collections to them. Secondly, the loan of material to Edinburgh from numerous European and S.W. Asian herbaria, and from private collections like those of Dr. A. Huber-Morath (who is one of our most valued contributors), Dr. K. P. Buttler and Dr. F. Sorger. We also have on long-term loan from Geneva (G), the extensive B. V. D. Post-Aznavour herbarium consisting mostly of specimens from the Bosphorus area.

Turkish botanists have greatly assisted the preparation of the Flora by sending us material as gifts or loans (often in exchange for identification), particularly from departments in Istanbul, Ankara and Ege Universities. The American Carl Tobey, living in Samsun, has provided us with important collections, chiefly from the central part of northern Anatolia. All this collaboration is encouraging, and is leading towards a more complete Flora. However, it can only be achieved at a considerable increase in postal expenses, and in additional time spent on clerical and editorial duties at Edinburgh (contributors differ markedly in the attention they pay to the Flora's format!). It is also an expensive and time-consuming task to organise the coming and going of extensive loans that can run into several thousands of sheets a year.

Three Turkish botanists have already contributed generic accounts to the Flora: Professor Hüsnü Demiriz, Doç. Dr. Faik Yaltirik and Dr. Hasan Peşmen. The work of the last two was largely done during an extended period of study at Edinburgh, and was of mutual benefit to them and to us.

Some valuable taxonomic contributions have been published in Turkey by Turkish botanists in recent years, mainly in Istanbul. Among those most useful for the Flora are the contributions by Professor A. Baytop (1966, 1971, etc.) on the flora of Turkey-in-Europe (supplementing Webb's formidable list, 1966, largely based on literature records), A. Baytop's revision of *Phalaris* (1969), Demiriz's contribution on the ferns (1969a) and Yaltirik's on woody groups (1971a, b). Various phytosociological papers have also been published from which floristic records can often be taken, e.g. Birand (1960), Kasapligil (1961), Quézel (1973), Quézel & Pamukcuoğlu (1970, 1973) and Yaltirik (1963). Mention, too, should be made of a paper by Birand (1952) entitled "A preliminary list of species collected in Turkey"; however, many of the records and identifications in this check-list are inaccurate and should be treated with caution.

Although we do not cover the non-vascular plants in the Flora, it is encouraging that Turkish botanists are now publishing in this neglected field where so much exploration is needed [Walther & Leblebici (1969, 1974) on bryophytes; Zeybek (1966) on marine *Algae*].

The Turkish flora is under-illustrated, and the plates published in Istanbul (Yakar, 1964-1966) were a development that we very much hope can be continued in some form.

Taxonomists writing basic Floras usually find it extremely difficult to discover much information about the cultivated, alien or naturalised plants of the country concerned. This is certainly true for the *Flora of Turkey.* Crop plants and plants commonly grown in parks, plantations, streets and public gardens are very poorly represented in general herbaria, so that both their identity and distribution are difficult to establish (as in, for example, *Acacia, Eucalyptus* and the *Cucurbitaceae*). The best general account of Turkey's crop plants is still that of Zhukovsky (1933) in which numerous cultivars are described. Kayacik (1963) is quite useful for naming park trees, Polunin & Huxley (1965) deal with, in addition to native species, some of the commoner amenity herbs and trees of the Mediterranean region, and by using El-Hadidi & Boulos (1968) some of the more exotic subtropical trees may be classified – as, for instance, *Brachychiton populneum (Sterculiaceae)* so common as a street tree in Adana and elsewhere but omitted from the Flora. Orçun's *Sus bitkileri* (Ornamental plants) we have not seen. No doubt useful works of identification are published in agricultural periodicals but these can be very difficult for floristic taxonomists to trace.

We would very much appreciate receiving reprints of all taxonomic, biosystematic, phytosociological and palaeobotanical articles published in Turkey that might be relevant in the preparation of the Flora or its Supplement.

The half-way stage of the flora

We have now passed the half-way stage in the proposed 8-volume Flora, with volume 5 now in press. This is the largest volume to date, being entirely devoted to the *Compositae.* Since the first volume was published in 1965, the Flora has gradually become more comprehensive and, one hopes, even more accurate. This is largely a result of a more thorough extraction of records from relevant literature, the compilation of a card index of obscure place names, and by the increasing number of specialists preparing accounts of difficult genera.

As the work has proceeded, so too has it become possible to start synthesizing information. For example, distribution patterns are now much clearer and more significant than before, with similar ranges being repeated by hundreds of species. On the basis of the published volumes, specific endemism is high, being 25-30% of the total flora. These endemics are scattered throughout the country, being found in each of the three phytogeographical regions although most abundant in the Irano-Turanian (the largest and most diverse of the three regions).

The majority of Turkish endemics appear to be relatively young. In such genera as *Alyssum, Aethionema, Erysimum, Astragalus* and *Onobrychis,* where there are

numerous endemics, they are often very closely related, difficult to distinguish from their allies and often replacing each other in different parts of Anatolia. We can probably safely assume that most such groups of endemics have differentiated in Anatolia.

However, several very distinct endemic species do occur, and many of these are found in N.E. Anatolia (the Colchic sector) or in S.W. Anatolia, both of which appear to have served as refugia in times of unfavourable climatic change. Centres of endemism occur in the provinces of Antalya, Erzincan and Hakkari, the mountain ranges of Bolkar Dağ, Amanos Dağlari and elsewhere, and the saline environs of the Tuz Gölü; areas of serpentine (Marmaris and Sandras Dağ) and chalk (Çankiri and Sivas) are also rich in endemics.

An interesting discovery made by Dr. J. Cullen, as a result of analysing patterns of distribution in the first two volumes of the Flora, was the importance of the "Anatolian Diagonal". This runs from Gümüsane southwest to the Anti-Taurus and beyond, thus splitting the Irano-Turanian territory of Anatolia into two floristic divisions. Hundreds of Turkish species do not extend east or west of this line, while a number of endemics are virtually restricted to the Diagonal belt. The reasons for this phenomenon are still not clear.

Although the percentage of specific endemism is high, few genera are endemic. In the first four volumes of the Flora there are only 10 endemic genera, each with only one or very few species (Davis, 1971). This low figure of generic endemism supports the assumption that much of the endemism in Anatolia is relatively recent. In the eastern part of the Irano-Turanian region as a whole, as for instance in Afghanistan (Hedge & Wendelbo, 1970) and Soviet Central Asia (Kamelin, 1965), the figures for generic endemism are higher, with many extremely distinct genera.

It should be stressed that the proportions of generic and specific endemism in Turkey are for a political area and as such can often be misleading. Figures for endemism in natural floristic regions are much more meaningful but more difficult to acquire (cf. Hedge, 1975 for *Cruciferae*). In compiling such data it is of course necessary to extract information from the Floras of surrounding or adjacent countries. Many of these Floras, such as *Flora europaea, Flora r. p. bulgaricae,* Townsend's *Flora of Iraq,* Rechinger's *Flora iranica,* Grossheim's *Flora Kavkaza,* Mouterde's *Nouvelle flore du Liban et de la Syrie,* and Zohary & Feinbrun-Dothan's *Flora palaestina,* have a long way to go before completion. When they are all finished in perhaps 10-15 years time, it will be possible to produce a more accurate estimate of endemism in, for example, the Irano-Turanian region, and to subdivide it into provinces. This aim will certainly be hampered, however, by differences in taxonomic treatment ("splitters" versus "lumpers") which make statistical analysis difficult.

It seems apposite here to add that after volume 5 *(Compositae)* of the Flora, volume 6 will include the *Campanulaceae, Ericaceae, Convolvulaceae, Boraginaceae, Scrophulariaceae* and allied families; volume 7 the *Plantaginaceae, Labiatae* and apetalous genera (excluding the Centrospermous families treated in volume 2) such as the catkinate trees and *Euphorbiaceae;* volume 8 will, with the Monocotyledons, conclude the main part of the Flora. To these future volumes Turkish taxonomists will contribute some accounts.

Future work on the Flora of Turkey

The important contributions which Turkish botanists can make to the Flora

The commonest reason for a competent taxonomist being unable to classify satisfactorily a difficult group of species is lack of adequate material – both of specimens and of information about them. If you went through the Flora systematically you would find that there are a number of endemics still only known from the type gathering collected over a hundred years ago, e.g. the monotypic Leguminous genus *Sartoria* from Geyik Dağ, and several species of *Astragalus*. It stands to reason that, if a species is only known from the type, one knows almost nothing about its variation. Under such circumstances it is often impossible to be sure whether certain species are distinct or not. It is possible that some Turkish endemics, such as those mentioned, may really be extinct, due to the influence of man or his flocks on the plant community. But extinction is probably the exception. Further exploration by Turkish botanists near the type locality would no doubt lead to the rediscovery of many rare species and consequently add to our knowledge of their variation.

Botanists interested in revising a particular genus should, of course, concentrate on collecting it particularly well. With some knowledge of the variation and taxonomic problems gained from the Flora and herbarium before you start, you have a great advantage in the field – you know what you are looking for and what kind of notes to make. The importance of good field-notes cannot be overemphasized: they provide, for instance, the herbarium taxonomist with most of his information on the distribution and habitat of a species. The general principle is to record on the label data that will not be apparent from the pressed specimen alone. The following data are needed: vilayet (and preferably the grid square used in the Flora, see vol. 1 map 1), altitude, habitat and/or community, additional information on the plant (e.g. flower-colour, smell, height of plant, depauperate, grazed or shade forms, whether annual, biennial or perennial herb, tree or shrub), date, collector and serial number. With that sort of information, combined with properly collected and well-preserved specimens, a taxonomist can do far more to solve his problems than he can with badly collected and badly labelled scraps that take up space in old herbaria. At this stage in our knowledge of the Turkish flora, quality is more important than quantity, and if a large area is being covered it would be advisable to concentrate on particular genera, e.g. those that are poorly represented in herbaria. Huber-Morath's (1971) revision of *Verbascum* in Turkey demonstrates how the systematic collecting of a neglected genus can revolutionise our knowledge of it.

It is often not realised by young collectors that in many groups fruiting material is often more important for identification than flowers. This is so in most *Cruciferae, Leguminosae, Umbelliferae, Compositae* and *Chenopodiaceae,* where it is generally a case of "no fruit, no name"! A note on features needing special attention is often given after generic descriptions in the Flora, but a look at the keys will usually indicate the kind of characters that are most useful for identifying the species of a particular genus.

Although the botanical exploration of Turkey by Turkish botanists has increased since we began the Flora, there are still many neglected areas deserving attention. The following vilayets (largely Irano-Turanian) appear to be still under-collected: Afyon, Eskişehir, Yozgat (mountains S.E. of Akdağmadeni), Adiyaman, Bingöl and Siirt. The high alpine regions in east Anatolia need further energetic exploration – camping out. Hakkari, though much visited in recent years, remains a cornucopia of new discoveries. The choice of season, of course, is extremely important. The floras of May and July, for instance, are so different that it is advisable to collect in the same area at least twice – an advantage, too, for collecting fruiting specimens (and seed) on the second visit of plants seen in flower on the first. Here resident botanists have a great advantage over the foreign visitor with limited time at his disposal. Many areas have only been collected in once, and by going at a different season a very different collection could be made. This applies particularly to bulbous plants, which are often difficult to find when not in flower. Aquatics, too, need more collecting – not neglecting the submerged species. Professor T. Baytop's (1949) account of the flora of Terkos Gölü was very welcome. Turkish botanists are in a favourable position for collecting in areas where species previously only known from a neighbouring country are likely to be added to the Turkish list.

Many species new to the Turkish flora have been collected since we began publishing the Flora. It was only recently that a very distinct new genus of *Cruciferae, Physocardamum davisii,* was found growing abundantly in the upper regions of the Murat valley in the province of Ağri (Hedge, 1968).

After the eighth volume is completed, a Supplement will be needed to bring the earlier volumes up-to-date, in order to include important discoveries, new records or earlier omissions, acceptable taxonomic and nomenclatural changes, and other relevant information. Huber-Morath (1966, 1973) has published important lists of distributional records additional to those given in the families dealt with in the first 3 volumes of the Flora. We sincerely hope that Turkish botanists will play an important part in seeing that the proposed supplementary volume (vol. 9) will be as comprehensive as possible.

The Flora as a foundation for more intensive research

With a view to improving the classification presented in the *Flora of Turkey,* two approaches are mainly needed: 1) better collecting of critical and under-collected groups (already dealt with in the previous subsection); 2) biosystematic research in the broadest sense, including the analysis of quantitative data, and experimental research (see Briggs & Walters, 1969; Heslop-Harrison, 1963; Heywood, 1967; Solbrig, 1970). Some relevant approaches are enumerated below.

A. Field studies

Many problems that face us in the herbarium, when we suspect that hybridisation between allied species may be involved, could no doubt be solved in the field by looking for putative parents and intermediates. At the same time, however, soil or other ecological preferences should be investigated to see if they are correlated with variation patterns.

Mass gatherings – random population samples – can clarify problems caused by lack of knowledge of species' variability. For instance, we would be more certain about species limits in the sections of spiny *Astragalus* if we had such information. In mixed populations the techniques of population analysis devised by Anderson (1949), particularly the pictorialised scatter diagram, will be found very useful for detecting hybridisation and introgression; experimental proof may be obtained in cultivation.

B. Cultivation

Collateral cultivation of groups can be usefully carried out where one suspects that environmental modifications rather than inherent genetic differences may be involved (Bradshaw, 1965). The importance of this simple technique, involving growing related plants side-by-side in an experimental garden, cannot be over-emphasized for solving many basic taxonomic problems (see work on *Puccinellia,* Jones & Newton, 1970). Nor can the importance of accurate data recording, efficient labelling, and regular weeding of the experimental plots be over-stressed if mistakes are not to be made (Lawrence, 1968; Marsden-Jones & Turrill, 1957).

C. Cytology and genetics

Except in a very few groups, chromosome counts for wild Turkish plants are extremely sparse (exceptions occur in *Rubiaceae:* Ehrendorfer, 1971, and *Ornithogalum:* Cullen & Ratter, 1967). Much basic work obviously needs to be done in this field, and it will of course be best to approach it on a systematic basis (genus by genus) if the results are to be assessed taxonomically. The cytological study of Favarger & Contandriopoulos (1961) on the Corsican flora is an important approach establishing the relative age of endemics and their allies. The most up-to-date world-wide compendium of chromosome counts and references is that of Fedorov (1969).

Investigation of the breeding system is another important line of research. We need to know whether the plant is self-incompatible or not and to establish whether populations are predominantly outbreeding, inbreeding or apomictic (Solbrig, 1968). All these are factors which have their morphological effect in producing different variability patterns. Establishing crossability criteria between related species is a longer, more complex, but necessary job when studying micro-evolution and applying the biological species concept (Ben-Ze'ev & Zohary, 1973; Faulkner, 1973).

Two other recent approaches, though hardly part of biosystematics, can produce very useful taxonomic evidence.

D. Microscopic studies

Although detailed investigations in plant structure have contributed to natural classification for over a century, in recent years technological advances and the advent of numerical taxonomy have encouraged further research in the microscopic field. A few useful examples of microscopic studies are cited here: embryology (Maheshwari, 1950); epidermal structures (Cottem, 1973; Pant, 1965; Stace, 1965); form and distribution of sclereids (Bokhari, 1970) and other anatomical features (Metcalfe, 1960-1972; Philipson & Philipson, 1968); pollen grains (Ferguson & Webb, 1970; Singupta, 1972); floral anatomy, including clearing techniques (Melville, 1962-1963; Sing & Sattler, 1972); structure of fruits and seeds (Heywood &

Dakshini, 1971; Wojciechowska, 1972). Such work has involved both light and scanning electron microscopy (Heywood, 1971a). Observation of microcharacters is proving extremely useful in monographic work (Stevens, 1971). A wealth of new microscopic data is now being handled by electronic computers to evaluate overall similarity – the dominant field in numerical taxonomy (Jardine & Sibson, 1971; Sokal & Sneath, 1973).

E. Chemical taxonomy

Secondary compounds of low molecular weight can provide useful taxonomic data that differ in value from group to group. For example, in the *Umbelliferae* acetylinic, flavonoid, coumarin and alkaloid patterns are all of some systematic relevance. A good review of the chemical patterns in this family is given by Hegnauer (1971). The importance of the betalains in aiding the delimitation of the *Centrospermae* is a classical example of the importance of a secondary compound in taxonomy, but one which is slightly out-of-step with a morphological circumscription of the group. Comparisons of proteins by means of serological or electrophoretic techniques have interesting systematic and phylogenetic implications, as shown by Smith's papers on the *Gramineae* (1969, 1972) and Johnson & Hall (1965). Like some of the aspects mentioned under headings (C) and (D), sophisticated modern techniques are involved that cannot be acquired except under well-informed and expert supervision; the results need more careful interpretation in terms of taxonomic classification than they often receive (Heslop-Harrison, 1963; Walters, 1963). Useful books on chemotaxonomy (including serology) are those by Alston & Turner (1963), Harborne (1973) and Hawkes (1968). Techniques, however, get superseded. The new journal called *Biochemical Systematics* (Pergamon Press) will help to keep taxonomists up-to-date. Both chemical and numerical taxonomy are relevant to monographic rather than floristic work.

F. The plant and its environment

Lastly a more broadly-based, general topic that combines observations in the field and experimental garden. The life histories of species and their relation to the environment (soil, climate, competition, predators, etc.) would make fascinating topics for post-graduate research. Field studies are of prime importance and in Turkey there is an enormous amount of new and basic biological information to be gathered in this line of research where taxonomy and ecology meet. Seedling development, methods of vegetative propagation, perennation, phenotypic plasticity (Bradshaw, 1965), the plants response to pests and diseases, pollination (Proctor & Yeo, 1973) and seed dispersal (Pijl, 1969) are not only biologically interesting but are often of taxonomic significance (Cain, 1959; Heywood, 1973). They also may be of economic importance. Chemical ecology is a recent development mainly dealing with the interactions between plants' secondary substances and their environment (Harborne, 1972; Sondheimer & Simeone, 1970).

We know very little about the duration and underground parts of many herbaceous plants; in *Isatis, Ferula* and *Cirsium,* for instance, it is often impossible to tell from average herbarium material whether a species is biennial, monocarpic or perennial; does *Vavilovia (Pisum) formosa* have a tap root or a tuber? Bulbous plants that flower before their leaves develop *(Biarum,* many *Crocus* and *Colchicum)* cannot be satisfactorily studied on the basis of herbarium material without being cultivated, so that both leaves and flowers (as well as underground parts) can be

preserved from the same plant. In *Colchicum* much taxonomic confusion has arisen by describing "species" based on the leaves of one species and the flowers of another! We should like to know more about the taxonomic distribution of synaptospermy (Murbeck, 1920), so characteristic of arid floras, or in which groups the tumbleweed habit occurs in the Anatolian steppe – both are features which are often confined to groups of related species (e.g. in *Trifolium, Centaurea, Phlomis, Bellevalia*).

Zohary's *Plant life of Palestine* (1962) contains many examples (and references) concerned with such matters, where function is of taxonomic importance. In Britain, the life histories of individual species in relation to their environment are treated in the "Biological Flora", the parts of which appear in most volumes of the *Journal of ecology*.

In Israel, Orshan (1953) has devised a life-form classification based on the protection of the whole plant against drought. This has proved far more effective in distinguishing between the Mediterranean and Irano-Turanian phytoclimates than Raunkiaer's classification, and might well be extended to the Turkish flora.

In all the work covered by the above six subheadings, whether descriptive or experimental, it is essential that *voucher specimens* should be preserved so that identifications can be checked by future workers. Thousands of chromosome counts in the past, for instance, are useless because the correct identification of the species is in doubt.

Some further considerations – theory and practice

Biosystematic information may explain variation patterns but it does not necessarily make them any easier to classify – often the reverse, particularly when there is a conflict between crossability and the degree of morphological difference. In such cases of conflict formal classification may need to be based primarily on the behaviour of the plants in the field, rather than on crossability in the experimental plot where isolating barriers that often prevent species from interbreeding in nature are largely eliminated (Davis & Heywood, 1967: chapter 13).

As the Turkish flora should not be studied in isolation before classifications are altered, it will be necessary to collate new information from field or cultivation with information on variability and distribution from other Floras and from herbaria outside Turkey; by this means all the facts available can be synthesized. It would, however, seem sensible to concentrate taxonomic studies on genera which have centres of speciation in Turkey. This would have the advantage of throwing light on the ways in which speciation has occurred in genera with a high percentage of endemism in Anatolia. Among many examples of such groups already included in the first four volumes of the Flora are the following: *Consolida, Isatis, Aethionema, Alyssum* sects. *Odontorrhena* & *Gamosepalum, Silene* sect. *Spergulifoliae, Petrorhagia* and *Velezia (Caryophyllaceae), Astragalus* sect. *Rhacophorus* and sect. *Pterophorus* (mass-gatherings needed), *Hedysarum, Potentilla, Pyrus* and *Rosularia*. Many smaller groups of species (and polymorphic species if not widespread outside Turkey) also need investigating, including the significance of the two varieties of *Liquidambar orientalis* (Peşmen in Davis, *Flora of Turkey* 4: 264).

It will be clear from the preceding paragraphs that there is a growing wealth of morpho-anatomical, biosystematic and chemical information that may be used for improving natural classification. In using such information it is important that *a priori* weighting should not be given to particular characters (Davis & Heywood, 1967: 49-51). The following are examples of work where a large amount of information from different biological fields has been synthesized to improve the taxonomic structure: Babcock (1947), Fisher (1965), Greuter (1973), Hawkes & Hjerting (1969), Heslop-Harrison (1948), Hutchinson & al. (1947), Johnson (1972), Rollins & Shaw (1973), Smith (1968, 1972), Snogerup (1967), Strid (1970).

We are still living in an age of basic Flora-writing, but in ten years or so this will have greatly diminished so far as the Middle East is concerned. Taxonomists will then have more time to concentrate on monographic research on genera and families.

Before we can very usefully speculate on the origin and development of the Turkish flora, we need to know a great deal more about Turkey's Tertiary and Quaternary history, particularly with regard to the chronology of land and sea connections, the formation of lakes and mountains, and the area's past climates (cf. van Zeist & al., 1968). More information is needed on Turkey's fossil floras and faunas, reliably identified and dated. No doubt Turkish geologists are working on some of these topics, but taxonomists find their contributions difficult to trace (reprints, please!). Although we now have a fair picture of the past history of the Aegean (Greuter, 1970), this does not seem to be the case for Anatolia, especially the eastern sector. The following publications are relevant to the geology, climate and biogeography of the ancient Tethys area, and cover the present east Mediterranean basin: Adams & Ager (1967: 247-334), Beug (1967), Braidwood & Howe (1960), Butzer (1958), Erinç (1954), Greuter (1970), Hughes (1973), King (1967), Kolakovski (1964), Takhtajan (1969: chapters 14-15), Tarling & Tarling (1971), Turrill (1929), Vita-Finzi (1969), Zeuner (1945: chapter 7), Zohary (1973: chapter 10). The most startling revelation is that of Hsü (1972) who produces evidence that, with the closing of the Straits of Gibraltar about 6 million years ago, the Mediterranean sea dried up, leaving a searing desert 3000 m below sea level! As this happened *after* the origin of the Mediterranean flora in the early Miocene (relicts of which persist in the Canaries), this catastrophic event (if substantiated) poses challenging problems to botanists trying to interpret the present distribution of the area's flora.

We venture to end this section with both a plea and a warning, in order to minimise damage to the practical taxonomic structure. It is all too easy to split species into two or more. This must not be done without taking all the evidence into account – not just from Turkey, but from other countries where the group occurs. Taxonomic treatment in a genus should be as consistent as possible. It is bad practice to split a polymorphic species into a complicated hierarchy of minor variants as done by some botanists in the past. The rank of species, subspecies and variety should be applied to *populations*, not to individual variants, and as far as possible should be used in accordance with certain principles (Davis & Heywood, 1967: chapter 3). Much of nature's variation is better treated informally, through discussion. Do not add, if it can possibly be helped, to the enormous burden of synonymy with which the taxonomist has to struggle. There is a deplorable modern trend to split genera too, so that we shall soon be left with no sections. *Thlaspi* (Meyer, 1973) has recently been divided into 12 independent genera! Most taxono-

mists seem to suffer from a basic urge to discover new species (whether in the field or herbarium) and to describe them. However, it is probable that there are more Angiosperm "species" known in the world that deserve reduction to synonymy than there are new species awaiting description. Taxonomists should remember that they contribute just as much to science by reducing bad species to synonymy as they do by describing new ones.

Editors of taxonomic journals, or journals in which taxonomic papers appear, bear a heavy responsibility to other taxonomists. They must ensure that the taxonomic conclusions to be published are reasonable, that the author is fully aware of other work in the same field, and (a very time-consuming task) that the presentation is clear and concise. When in doubt about the contents of a paper, editors should ask the advice of a specialist – though his reply may need to be treated with caution, too! The taxonomic judgments adopted in *Flora of Turkey* volume 3 have recently suffered from what we consider a serious lapse by the editors of *Feddes repertorium.* In a paper by Ponert (1973) hundreds of changes in rank and new taxa (254 in all!) were made in the *Leguminosae,* most of them trivial and questionable. This could only be justified if the author had based his contribution on a reassessment of the material and preferably on additional information. He did not. The changes he made, which will burden all taxonomists working on East European and Middle East floras, were almost entirely based on observations on variability made in the Flora, deliberately given as informal comments because we did not have sufficient information to justify altering the taxonomic treatment. Neither did Ponert. When he submitted his paper, the specimens we had studied had not even been seen by him (Huber-Morath, 1975)!

A plea for a national taxonomic institute

Taxonomic research in Turkey has so far been mainly confined to the Universities of Ankara, Izmir and particularly Istanbul.[1] However, for different biology departments to build up major Turkish herbaria and struggle to expand their taxonomic libraries does not seem the best way to develop. It leads to much duplication of material, and dissipation of money, man-power and curatorial duties. It is also potentially hazardous, if experience in western Europe is anything to go by. Taxonomic interests change at the whim of new heads of departments; university herbaria tend to get neglected, with disastrous results to the specimens, or even to be disposed of (McNeill, 1968).

Fortunately in Europe there are many herbaria, not controlled by Universities, which are national, in practice if not in name. One of their basic functions is the permanent safe preservation of material entrusted to their care; another is the gradual expansion of a taxonomic library that will enable floristic and monographic work to be effectively carried out. Often, as at Berlin, Geneva, Leningrad, Kew and Edinburgh, botanic gardens are attached to such herbaria, and used for instruction, pleasure and scientific research. There are often close links with

[1] For a report on the present situation and contents of herbaria in Turkey, see Demiriz (1969b).

university departments and reciprocal arrangements between institute and university staffs for the supervision of post-graduate research.

It is never easy to set up a new national institute – much money, thought, goodwill and determination are needed – but may we make a strong plea for a national herbarium in Turkey, if possible as part of a broadly-based taxonomic institute? The Turkish collection would need to enlarge in a broader framework, being supplemented by representative collections from surrounding countries, so that floristic comparisons could be made; foreign collections could be readily acquired through exchange. Such a taxonomic institute would act as the main focal point for taxonomic research in Turkey and, in association with university departments, thus benefit botany, ecology, forestry and agriculture. Taxonomic research in Turkey is at present still in its developmental stages, but is obviously going to expand greatly in the years to come. Now is the time for the best possible foundations to be laid.

Conservation

Everyone interested in conservation in the Near East must welcome the establishment of eight national parks and the moves taken to conserve the richness of Turkey's unique vegetation and flora. Most of these parks are forest areas (Kayacik & Yaltirik, 1971). We look forward to reserves in other types of vegetation, as for example the setting up of reserves in the Anatolian steppe where, as elsewhere, disastrous injuries have already been inflicted on the native flora. The Irano-Turanian flora is the richest in Turkey, and the conservation of its genetic resources is a matter of urgent economic importance, as was stressed at the symposium "Plant Life of South-West Asia", held in Edinburgh in 1970 (Bennett, 1970, 1971; Poore, 1971).

The rape of Turkish populations of rare bulbs (in their thousands) by unscrupulous commercial collectors has been a disaster (e.g. the decimation of *Chionodoxa* in west Anatolia). The conservation of many bulbous plants in F.A.O.'s centre in Izmir is a welcome development. As the genetic resources of Turkey were never explored by Vavilov (1949-1950), surely Anatolia's native and naturalised fruit trees (especially *Pyrus*, whose taxonomy is still unclear) deserve more extensive exploration than they have yet received (Sykes, 1972). The build-up of a cultivated collection of such trees would enable their economic potentialities in breeding work to be investigated. An up-to-date survey of some of the important genetic centres of cereals, grain legumes and cultivated fruit trees in the Middle East is given in a recent F.A.O. publication (Frankel, 1973), although the distribution of rosaceous fruit trees in E. Anatolia is inadequately shown.

Although everything must be done to preserve rare plants from destruction, in general extinction is brought about by such anthropogenic activities as deforestation, burning, over-grazing and the general spread of cultivation. However, without responsible and better collecting, we cannot know what most needs conserving. Botanists collecting on a line across an otherwise largely uninvestigated area usually do far less damage to the gene pool than a solitary goat!

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Özet

Edinburgh'da hazırlanan ve sekiz cilt olacağı tasarlanan *Türkiye Florası* projesinin dördüncü cildinin de basılması ile yarı yoluna ulaştığı şu an; Floranın temeli, gayesi, bugünkü durumu ile halen yapılmakta olan çalışmaları yeniden gözden geçirmek için en uygun zamandır. Bu konularla ilgili olarak bu yazı üç ana kısma bölünmüştür.

İlk konu, 8000 tür civarında çiçekli bitkileri ihtiva eden bir büyük floranın yazılmasında karşılaşılan güçlükleri kapsar. Aynı iş yapılırken, Batı Avrupanın avantaj ve dezavantajlarına Türkiyenin sahip olup olmadığı incelenir. Flora standardlarının korunması ve geliştirilmesinde dünya botanik kuruluşlarının işbirliği ve yardımlaşması, özellikle Türk botanikçileri ile kurulan yakın münasebetin devamı, üzerinde önemle durulması gereken bir konudur.

Yazının ikinci kısmında, Floranın neşredilmiş bölümlerindeki bilgilerin de ışığında, endemizm ve dağılma konuları işlenmiştir. Bu tip karşılaştırmalı çalışmalarda Kafkasya, Bulgaristan, Kırım, Iran, Irak, Lübnan ve Suriye gibi Floraları halen yazılmış bulunan komşu ülke ve bölgelerin de floristik bakımdan dikkate alınmaları icabeder.

Yazının üçüncü kısmında ise, gelecek ve gelecekte Türk botanikçilerinin genel botanik bilimine ve özellikle *Türkiye Florasına* yapacakları yardımlar tartışılır. Bu hususta bazı konular şöyle özetlenebilir: Daha ileri araştırma ihtiyacı ve daha iyi toplamalar; Melezlenme, Kontrollu tarım, sitoloji ve genetik gibi biyosistematik çalışmalar; taksonomik yapıların çeşitleri konusunda detaylı mikroskobik çalışmalar; kimyasal taksonomi; bitkinin çevre ile ilişkisi. Şimdi Flora yazımının başlangıç devresinde bulunuyoruz. Gelecekte ise monografik çalışmalara daha çok önem verilecektir. Yetersiz sebeblerle halihazırdaki sistematik yapıda tehlikeli ve uygunsuz değişiklikler yapmak da üzerinde önemle durulacak bir konudur. Türkiyedeki taksonomik çalışmalar için bir Milli Türkiye Herbaryumu kurmak şarttır. Böyle bir kuruluşta Türkiye bitkileri ile birlikte, komşu ülkelerin bitkileri de temsil edilmeli ve bu kuruluşa, taksonominin çeşitli dallarında araştırma yapmaya imkan verecek bir botanik bahçesi de eklenmelidir. Yazı Türkiye florasının kıymetli genetik kaynaklarının korunmasına da yardımcı olabilecek, tabiatı koruma sahalarının kurulması ve muhafaza edilmesinin önemine işaret ederek sonuçlanmaktadır.

Referansların seçiminde, daha çok, konu ile ilgili olarak son yıllarda neşredilen kitap ve yazıların geniş bir şekilde verilmesine çalışılmıştır.

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